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ABSTRACT

The basic concepts and several examples of the effects of the physical environment on man are discussed. Aesthetic judgments of the environment are related primarily to the physiological well-being of an individual and secondarily to his social experiences. Excessive loading of any one of the senses can prevent a balanced assessment of the environment. Therefore, the responsibility of architecture is to lighten the stresses of life, permitting man to focus his energies upon productive work. Several examples explain this basic premise--(1) the child in a learning environment, (2) the patient convalescing in a hospital, and (3) the surgeon in an operating room. (TC)

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THE AESTHETICS OF FUNCTION

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A fundamental weakness in most discussions of aesthetics is the failure to relate it to experiential reality. Most literature on aesthetics tends to isolate it from this matrix of experience, to discuss the aesthetics process as though it were an abstract problem in logic.

Art and architectural criticism suffers from this conceptual limitation. This finds expression in a persistent tendency to discuss art forms and buildings as though they were exclusively visual phenomena. This leads to serious misconceptions as to the actual relationship between the artifact and the human being. Our very terminology reveals this misapprehension: we speak of art as having "spectators," artists as having "audiences." This suggests that man exists in some dimension quite separate and apart from his artifacts; that the only contact between the two is this narrow channel of vision or hearing; and that this contact is unaffected by the environmental circumstances in which it occurs. The facts are quite otherwise and our modes of thought should be revised to correspond to them.

Art and architecture, like man himself, are totally submerged in an exterior environment. Thus they can never be felt, perceived, experienced in anything less than multi-dimensional totality. A change in one aspect or quality of the environment inevitably affects our response to, and perception of, all the rest. The primary significance of a painting may indeed be visual; or of a concert, sonic: but perception of these art forms occurs in a situation of experiential totality. Recognition of this is crucial for aesthetic theory, above all for architectural aesthetics. Far from being based narrowly upon any single sense of perception like vision, architectural aesthetics actually derives from the body's *total* response to, and perception of, its external physical environment. It is literally impossible to experience architecture in any "simpler" way. *In architecture, there are no spectators: there are only participants.* The body of architectural criticism which pretends otherwise is based upon photographs of buildings and not actual exposure to architecture at all.

Life is coexistant and coextensive with the external natural environment in which the body is submerged. The body's dependence upon this external environment is absolute–in the fullest sense of the word, *uterine.* And yet, unlike the womb, the external natural environment does not afford optimum conditions for the existence of the individual. The animal body, for its survival, maintains its own special internal environment. In man, this internal environment is so distinct in its nature and so constant in its properties that it has been given its own name, "homeostasis". Since the natural environment is anything but constant in either time or space, the contradictions between internal requirements and external conditions are normally stressful. The body has wonderful mechanisms for adjusting to external variations, e.g., the eye's capacity to adjust to enormous variations in the luminous environment or the adjustability of the heat-exchange mechanism of the skin. But the limits of adaptation are sharp and obdurate. Above or below them, an ameliorating element, a "third" environment, is required.

Before birth, the womb affords this to the foetus. But man, once born into the world, enters into a much more complex relationship with his external environment. Existence now is on two distinct levels, simultaneously and indissolubly

connected, the metabolic and the perceptual. (FIGURE 1.) The metabolic process remains basic. It is at once a "preconscious" state and the material basis of consciousness. Many of life's fundamental processes transpire at this level: heart beat, respiration, digestion, hypothalmic heat exchange controls, etc. Metabolic disturbance occurs only when the external environment begins to drop below the minimal, or rise above the maximal, requirements of existence. And sensual perception of the external environment comes into play only *after* these minimal requirements are met. (As a matter of fact, loss of consciousness is one of the body's characteristic responses to environmental stress—drop in oxygen or pressure, extremes of heat and cold, etc.)

Metabolic process then is clearly the precondition to sensory perception, just as sensory perception is the material basis of the aesthetic process. But the aesthetic process only begins to operate maximally, i.e., as a uniquely human faculty, when the impact upon the body of all environmental forces are held within tolerable limits (limits which, as we have said, are established by the body itself.) Thus, we can construct a kind of ~~experimental~~ experiential spectrum of stress. The work of psychiatrists like Dr. George Ruff at the University of Pennsylvania establishes the lower end of this spectrum: sensory overloading is destructive, first of balanced judgments, then of rationality itself.[1] But the other end of this spectrum proves equally destructive. Investigations of the effects of sensory deprivation, such as those carried on by Dr. Philip Solomon of the Harvard Medical School, indicate that too little environmental stress (and hence too little sensory stimula-

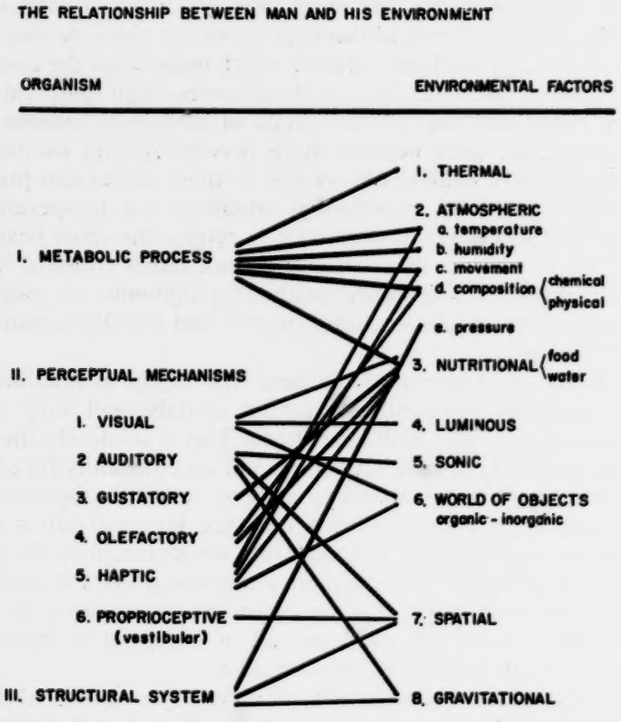

FIGURE 1. The relationship of the metabolic process to its environmental support is literally uterine. And since the process is the substructure of consciousness, sensory perception of changes in the environment in which the body finds itself is totally dependent upon satisfaction of the body's minimal metabolic requirements.

Page 707, line 16 should read "...we can construct a kind of experiential spectrum of stress."

tion) is as deleterious to the body as too much. Volunteer subjects for Dr. Solomon's experiments were reduced to gibbering incoherence in a matter of a few hours by being isolated from all visual, sonic, haptic and thermal stimulation.[2]

Psychic satisfaction with a given situation is thus directly related to physiologic well-being, just as dissatisfaction must be related to discomfort. A condition of neither too great nor too little sensory stimulation permits the fullest exercise of the critical faculties upon that situation or any aspect of it. But even this proposition will not be indefinitely extensible in time. As one investigator has observed in a recent paper (significantly entitled *The Pathology of Boredom*)[3]: "variety is not the spice of life; it is the very stuff of it." The psychosomatic equilibrium which the body always seeks is dynamic, a continual resolution of opposites. Every experience has built-in time limits. Perception itself has thresholds. One is purely quantative: the ear cannot perceive sounds above 18,000 cycles per second; the eye does not perceive radiation below 3,200 Angstroms. But another set of thresholds are functions of time: constant exposure to steady stimulation at some fixed level will ultimately deaden perception. This is true of many odors, of "white" sounds and of some aspects of touch

Of course, even more important facts prevent any mechanistic equating of physical comfort with aesthetic satisfaction. For while all human standards of beauty and ugliness stand ultimately upon a bedrock of material existence, the standards themselves vary astonishingly. All men have always been submerged in the environment. All men have always had the same sensory apparatus for perceiving changes in its qualities and dimensions. All men have always had the same central nervous system for analyzing and responding to the stimuli thus perceived. The physiological limits of this experience are absolute and intractable. Ultimately, it is physiology, and not culture, which establishes the levels at which sensory stimuli become traumatic. With such extremes—high temperatures, blinding lights, cutting edges and heavy blows, noise at blast level, intense concentrations of odor—experience goes beyond mere perception and becomes somatic stress. Moreover, excessive loading of any one of these senses can prevent a balanced assessment of the total experiential situation. (A temperature of 120 degrees F. or a sound level of 120 decibels can render the most beautiful room uninhabitable.) But as long as these stimuli do not reach stressful levels of intensity, rational assessment and hence aesthetic judgments are possible. Then formal criteria, derived from personal idiosyncrasy and socially-conditioned value judgments, come into play.

The value judgments that men apply to these stimuli, the evaluation they make of the total experience as being either beautiful or ugly, will vary: measurably with the individual, enormously with his culture. This is so clearly the case in the history of art that it should not need repeating. Yet we constantly forget it. Today, anthropology, ethnology and archaeology alike show us the immense range of aesthetically satisfactory standards which the race has evolved in its history: from cannibalism to vegetarianism in food; from the pyramid to the curtain wall in architecture; from polygamy and polyandry to monogamy and celibacy in sex; from hoopskirt to bikini in dress. Yet we often act, even today, as if our own aesthetic criteria were absolutely valid instead of being, as is indeed the case, absolutely relative for all cultures except our own.

Our aesthetic judgments are substantially modified by non-sensual data derived from social experience. This again can be easily confirmed in daily life. It is ultimately our faith in antiseptic measures that make the immaculate white nurses, uniforms and spotless sheets of the hospitals so reassuring. It is our knowledge of their cost which exaggerates the visual difference between diamonds and crys-

tal, or the gustatory difference between the flavor of pheasant and chicken. It is our knowledge of Hitler Germany which has converted the swastika from the good luck sign of the American Indians to the hated symbol of Nazi terror. All sensory perception is modified by consciousness. Consciousness applies to received stimuli, the criteria of digested experience, whether acquired by the individual or received by him from his culture. The aesthetic process cannot be isolated from this matrix of experiential reality. It constitutes, rather, a quintessential evaluation of and judgment on it.

Once in the world, man is submerged in his natural external environment as completely as the fish in water. Unlike the fish in his aqueous abode, however, he has developed the capacity to modify it in his favor. Simply as an animal, he might have survived without this capacity. Theoretically, at least, he might have migrated like the bird or hibernated like the bear. There are even a few favored spots on earth, like Hawaii, in which biological survival might have been possible without any modification. But, on the base of sheer biological existence, man builds a vast superstructure of institutions, processes and activities: and these could not survive exposure to the natural environment even in those climates in which, biologically, man could.

Thus man was compelled to invent architecture in order to become man. By means of it he surrounded himself with a new environment, tailored to his specifications; a "third" environment interposed between himself and the world. Architecture, is thus *an instrument whose central function is to intervene in man's favor.* The building—and, by extension, the city—has the function of lightening the stress of life; of taking the raw environmental load off man's shoulders; of permitting *homo fabricans* to focus his energies upon productive work.

The building, even in its simplest forms, invests man, surrounds and encapsulates him at every level of his existence, metabolically and perceptually. For this reason, it must be regarded as a very special kind of container. (FIGURE 2.) Far from offering solid, impermeable barriers to the natural environment, its outer surfaces come more and more closely to resemble permeable membranes which can accept or reject any environmental force. Again, the uterine analogy; and not accidentally, for with such convertibility in the container's walls, man can modulate the play of environmental forces upon himself and his processes, to guarantee their uninterrupted development, in very much the same way as the mother's body protects the embryo. Good architecture must thus meet criteria much more complex than those applied to other forms of art. And this confronts the architect, especially the contemporary architect, with a formidable range of subtle problems.

All architects aspire to give their clients beautiful buildings. But "beauty" is not a discrete property of the building: it describes, rather, the client's response to the building's impact upon him. This response is extremely complex. Psychic in nature, it is based upon somatic stimulation. Architecture, even more than agriculture, is the most environmental of man's activities. Unlike the other forms of art—painting, music, dance—its impact upon man is total. Thus the aesthetic enjoyment of an actual building cannot be merely a matter of vision (as most criticism tacitly assumes). It can only be a matter of total sensory perception. And that perceptual process must in turn have adequate biological support. To be truly satisfactory, the building must meet *all* the body's requirements, for it is not just upon the eye but upon the whole man that its impact falls.

From this it follows also that the architect has no direct access to his client's subjective existence: the only channels of communication open to him are objective, somatic. Only by manipulating the physical properties of his environment—heat, air, light, color, odor, sound, surface and space—can the architect com-

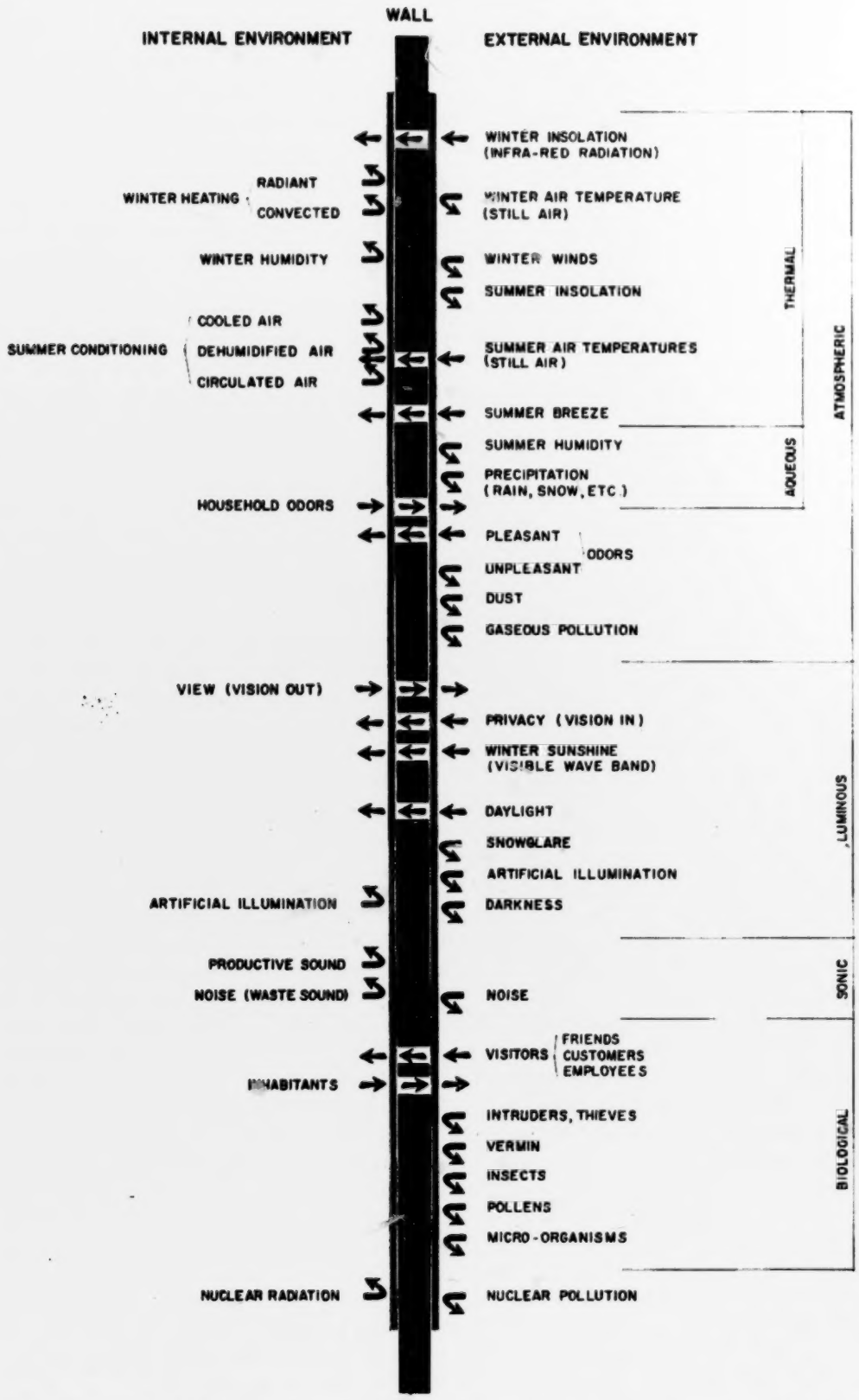

FIGURE 2. The building wall can no longer be considered as an impermeable barrier separating two environments. Rather, it must be designed as a permeable filter, capable of sophisticated response to the wide range of environmental forces acting upon it. Like the uterus, its task is the modulation of these forces in the interests of its inhabitants—the creation of a "third environment" designed in man's favor.

municate with his client at all. And only by *doing it well*, i.e., meeting all man's requirements, objective and subjective, can he create buildings which men may find beautiful.

The matter by no means ends here, however. The architect builds not merely for man at rest, man in the abstract. Typically, he builds for man at work. And this confronts him with another set of contradictions. For work is not a "natural" activity, as Hannah Arendt has brilliantly reminded us.[4] Labor, according to her definition, is "natural"—that is, the use of the whole body to meet its biological needs, to feed it, bathe it, dress it, protect it from attack. Work, on the other hand, is "unnatural"—the use of the hand and the brain to produce the artificial, non-biological world of human artifice (skyscrapers, textbooks, paintings, space ships, highways, symphonies and pharmaceuticals.) Both levels of human activity are, of course, fundamental to civilization and the world of work can only exist as a superstructure on the world of labor. But insofar as we share the world of labor with the beasts, it can fairly be described as both natural and subhuman. Only the world of work, of human thought and artifice, is truly human.

This distinction is not so fine as it might at first appear: it has important consequences for architectural design. For if the architect ever builds for the wholly "natural" man, it will be only in his house, at his biological activities of resting, eating, lovemaking and play. Most other modern building types involve man at work, engaged in a wide spectrum of "unnatural" processes. Each of these involves stress. Stress, as we have seen, comes either from too much or too little stimulation, from sensory "overloading" and "underloading" alike. Biological man requires a dynamic balance, a golden mean between extremes. But modern work knows no such requirements: on the contrary, for maximum output and optimum quality, it sometimes implies environments of absolute constancy (e.g., pharmaceuticals, printing) and often requires extreme conditions never met in nature (e.g., high-temperature metallurgy, cobalt radiation therapy, etc.)

When plotted, these two sets of requirements will seldom lie along the same curve. From this it follows that architecture must meet two distinctly different sets of environmental criteria—those of man at some "unnatural" task, and those of the "unnatural" process itself.

Variety may indeed be the very stuff of man's natural life. But most of our human activities are, to a greater or lesser extent, "unnatural". From the moment we place the young child in kindergarten, we are imposing "unnatural" tasks upon him—placing his eyesight, his posture, his capacity for attention under quite abnormal stress. And this situation grows more acute throughout his education and his normal working life. As an adult, his biological existence is linked to processes which are never completely congruent with his own. Often they involve work which is fractionalized, repetitive and hence often unintelligible to the individual; often, the processes are actually dangerous to him. Only in agriculture does he confront work whose "natural" environment, rhythms and wholeness correspond to his own; but only six out of one hundred American workers are involved nowadays in this work.

The child at school faces a situation not qualitatively different from his father on the job: namely, to accomplish a given amount of work in a given time. Ideally, his physical growth and intellectual development should be steady and parallel. His rate of development should be as high at the end of his school day as at its beginning. In reality, of course, this is impossible. His energies flag as the day advances and nothing but play, food and rest will restore them. The question for architects is how should the classroom intervene in his favor? How to manipu-

late his external environment so that his learning advances with optimum speed and minimum stress?

It should be immediatley apparent that the child's requirements are dynamic and imply a dynamic relationship with his classroom. No classroom should confront the child with a fixed set of day-long environmental norms, e.g., 72°F. air, 50 per cent humidity, 60 foot lamberts at desk top, 45 decibels of sound. Far from being held at some fixed level, the probability is that environmental conditions should be continually changing. *But this change cannot be casual or statistically indeterminate* (if change alone were all that was required, the class could be held in a nearby meadow). It must be a *designed* response to the child's changing requirements. The child may well need less heat at 2 p.m. than at 9 a.m. At day's end he may need less humidity and more oxygen; he may require more light and a different color; he may need a chair that gives a different posture or sound levels higher or lower than the morning. Whatever the requirements are, they could only derive from the child himself, in the experiential circumstances of study. They cannot be met by mechanistic engineers (windowless classrooms, "steady state" controls) nor by formalistic architects who design as though visual perception is the whole of experience.

But the symbiotic relationship between the architectural container and the men and processes contained is nowhere clearer than in the modern hospital. Here we find every degree of biological stress, including that of birth and of death. Here we find a wide range of highly specialized technologies, each with its own environmental requirements. And here we find the narrowest margins for error of any building type: here success or failure are literally matters of life or death. Here, if anywhere, we can observe the integral connections of metabolic function and aesthetic response as shown in FIGURE 1.

The seriously ill patient—above all, the major surgery case—will traverse the full experiential spectrum during his stay at the hospital. Stress will be greatest under surgery. His relationship with his environment can be almost wholly de-

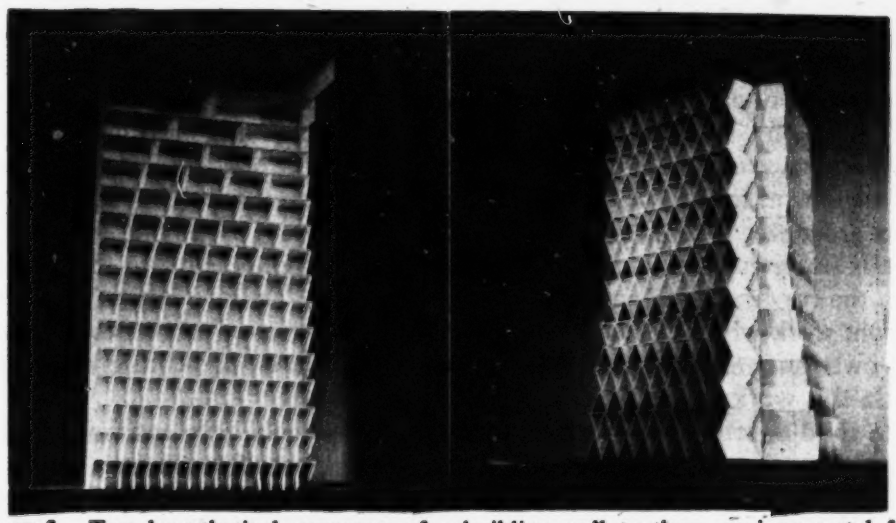

FIGURE 3. Two hypothetical responses of a building wall to three environmental forces only: gravity; maximum windloads of 100 m.p.h.; and the incident solar radiation of 30 Latitude North. Design requirement assumed was a wall whose cross section was capable of excluding all direct solar radiation, at all times of day or seasons of the year. Prof. Ralph Knowles of the School of Architecture at University of Southern California was the architect.

fined in somatic terms. Since he is under total anesthesia, there is no aesthetic aspect to his experience. (It is interesting, in this connection, to note that the two words anesthesia and aesthetic have a common origin in the Greek word meaning "to feel" or "to perceive")

His gradual process of convalescence—through the recovery room, intensive nursing, regular nursing and ambulatory state, on up to discharge—traverses the full spectrum of experience. Precisely as the metabolic crisis diminishes so will his aesthetic response rise to the front of consciousness. Colors, lights, noises and odors which he was too ill to notice can now become major factors of experience. And their satisfactory manipulation become matters of active therapy.

The surgeon and his staff too will meet their greatest period of stress during surgery. At this juncture their requirements will be opposed to those of the patient. Where the latter requires warm moist air (and anti-explosive measures demand even higher humidities), the staff under nervous tension should ideally be submerged in dry, cool air. But since stress for them is of limited duration while any added load might be disastrous for the patient, the room's thermo-atmospheric environment is usually designed in the latter's favor. The staff sweats and suffers and recovers later. On the other hand, the luminous environment of the operating room must be wholly designed in the surgeon's favor (and no contradiction is raised because of the patient's lack of consciousness). The color of the walls, of the uniforms, even of the towels is quite as important to visual acuity of the surgeon as the lighting fixture themselves.

Thus, every decision made in design of the operating room will be based upon functional considerations, objectively evaluated. The very nature of the intervention prohibits any abstractly "aesthetic" considerations. The margin of safety is too narrow to allow the architect the luxury of any formalistic decisions based upon subjective preferences. In varying degrees, this situation will obtain in other specialized areas of the hospital. And it will increase as the hospital comes to be regarded not merely as a container for men and processes but as being itself an actual instrument of therapy. There are many evidences of this tendency already: the hyperbaric chamber where barometric pressure and oxygen content are manipulated in the treatment of both circulatory disorders and gas gangrene; the metabolic surgery suites where body temperatures are reduced to slow the metabolic rate before difficult surgery; the use of saturated atmospheres for serious cases of burn; artificially-cooled, dry air to lighten the thermal stress on cardiac cases; the use of electrostatic precipitation and ultraviolet radiation to produce completely sterile atmospheres for difficult respiratory ailments or to prevent cross-infection from contagious diseases. Here the building is not merely manipulating the natural environment in the patient's favor but actually creating totally new environments with no precedent in nature as specific instruments of therapy.

The exact point in hospitalization at which these environmental manipulations cease to be purely therapeutic and become merely questions of comfort or satisfaction, i.e., the point at which they cease to be functional and become aesthetic problems, is not easy to isolate. Objectionable odors, disturbing noises and lights; uncomfortable beds; lack of privacy; hot, humid atmosphere—all these will work against "beauty" in the hospital room. They may also delay convalescence. We cannot hope to make modern medical procedures "pretty" and the well-adjusted patient will probably want to leave the hospital as soon as possible under any circumstances. All the more reason, then, that every external factor be analyzed as objectively as possible, with a view to removing all unnecessary stress.

All of this suggests the possibility of establishing, much more precisely than ever before, an objective basis for aesthetic decision. It would be mistaken to

attach too much importance to aesthetics in hospital design; but it would be equally foolish to minimize it. It cannot, in any case, be avoided. Everything the architect does, every form he adopts or material he specifies, has aesthetic repercussions. His problem is thus not Hamlet's: to act or not to act. It is rather to act wisely, understanding the total consequences of his decision.

A monograph such as this is an appropriate place in which to formulate such a proposition. For if the architect's aesthetic standards are to be placed on a firmer factual basis than the one on which they now stand, he will need the help of physiologists and psychologists to do it. Architecture needs a much more systematic and detailed investigation of man's actual psychosomatic relationship with his environment than has yet been attempted, at least in architecture. It is not at all accidental that we can find the broad lines of such research appearing in the field of aerospace medicine. For man can only penetrate space by encapsulating himself in a container of terrestial environment. And to accomplish this he must ask fundamental questions: what, actually, *is* this environment? What specifically is its effect upon us? What *is* its relation to human pleasure and delight?

In the design of the space vehicle, for example, it is no longer possible to say where problems of simple biological survival leave off and more complex questions of human satisfaction begin. Clearly, they constitute different ends of one uninterrupted spectrum of human experience. It is very probable that the upper end of this spectrum, involving as it does man's innermost subjective existence, can never be fully explored or understood. But it could certainly be far better understood than it is today, even among architects and doctors.

American society today employs some 270 distinct building types to provide the specialized environments required by its multiform activities. Most of them embody contradictions which must be resolved at two different levels: first between the persons and processes contained and then between their container and the natural environment. Respect for these two conditions is mandatory if the building is to be operationally successful. And yet, respect for these two conditions will often leave the architect with little room in which he can manipulate the building for purely formal, i.e., aesthetic, ends.

Most contemporary failures in architecture (and they are very many) stem either from a failure to understand this situation or else from a refusal to come to terms with it. Of course, no building can grow like an organism. Architects do not work with living tissue, with its powers of cellular division and genetic memory. In this sense, buildings must always be designed by men and these men will always bring to the task preconceived ideas of what forms they ought to assume. As Ernst Fischer, the Austrian philosopher has said, a good honey bee will often put a bad architect to shame. "But what from the very first distinguishes the most incompetent of architects from the best of bees is that the architect has built a cell in his head before he constructs it in wax."[5] Good or bad, beautiful or ugly, the building is always the expression of somebody's creative ambitions. Today, more than ever in history, these ambitions must be contained, structured and disciplined by objectively verifiable terms of reference.

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